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Respiration and morphology of mitochondria in the crowns of winter wheat plants exposed to low temperatures and cartolin

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Abstract

The respiration and ultrastructure of mitochondria from winter wheat (Triticum aestivum L.) crowns were studied with emphasis on the adaptation of plants to low temperatures during the autumn-winter period under field conditions. Analysis of the separate and combined oxidation of substrates revealed competitive relations between succinate dehydrogenase and malate dehydrogenase - the mutual inhibition of these enzymes. Succinate was the preferable substrate of oxidation compared to malate during autumnal months, but the predominance of succinate oxidation diminished during cold hardening. During cold hardening, mitochondria change their shape, e.g., their cross-sections acquired toroidal, dumbbell-shaped, and other unusual profiles. Presowing treatment of seeds with the growth regulator cartolin raised the morphological heterogeneity of mitochondria, caused their association into reticular structures, induced the "succinate-type" of respiration, and elevated the rate of cyanide-resistant electron flow. All this indicates intense energy metabolism, which promotes metabolic adaptation. Freezing temperatures induced the "disintegration" of complex mitochondrial profiles, degeneration of cristae, clarification of the mitochondrial matrix, and depression of the oxidation rate. At the same time, freezing temperatures led to an increase in the plasmalemma area at the expense of numerous foldings and invaginations, and the induction of endocytosis. It is concluded that compensatory rearrangements of mitochondria and plasmalemma during cell adaptation to low temperatures depend on the degree and duration of cooling.

Keywords

Cartolin, Low temperature, Mitochondria, Respiration, Triticum aestivum